Foundry for Patterned Chemistry

Leader: Neal Woodbury

Team: Neal Woodbury, Phil Stafford, Antonia Pompodreau, Zhao Zhang, Hao Yan, Dmitry Matyushov

Summary:

Occasionally, a set of key technologies converge in such a way as to create a capability that revolutionizes a field and/or creates completely new fields. It appears that we are on the edge of such a revolution, in which high resolution materials engineering, computational chemistry and programmed molecular assembly can come together to create chemical and hybrid electronic systems that achieve a complexity and diversity of function rivaling that of biology. In recent years we have had the pleasure of collaborating with Dmitry Matyushov who is taking computational chemistry to new levels of prediction and Hao Yan, who has without question become one of the world leaders in programmed molecular assembly. Working with these individuals has shown us that both of these fields have dramatically advanced in recent years, computation due to a combination of chemical understanding, algorithm development and the availability of advanced computing resources and programmed molecular assembly due to a combination of raw creativity and better and better (and cheaper and cheaper) sources of molecular scaffolding materials. Between these two areas, there is the potential now to perform detailed engineering at the nanoscale, but create large enough amounts of material through programmed self-assembly so that complex macroscale functionalities can be realized. One might call this "truly synthetic biology" -- starting from chemical building blocks and creating systems that have a life-like complexity of function. In the end the difference between what we can do and what biology can do will stem from the fact that biology was constrained to utilize high-abundance materials at the surface of the earth combined together via purely random associations. In principle, we have the entire Aldrich chemical catalogue at our disposal and the computational ability to guide the development of molecules and functional materials in ways that evolution could never have achieved. In addition, if we design these systems correctly, they will be able to interface with the electronic world (either directly or via optics), such that information can flow in and out of them in a facile way.

Value proposition:

CIM scientists and collaborators have spent years creating the platforms for making chips with high chemical diversity. Particularly with peptides we have shown that these chips can be used for many different applications, including immunosignaturing diagnostics, therapeutics, enzyme modulation.

Collaboration objectives:

This platform offers basically unlimited potential for applications in clinical research, veterinary research, chemistry and biology. We are particularly interested in collaborators with a particular clinical objective, signal processing experts, modelers and informaticists.

Contact: Neal Woodbury or Stephen Albert Johnston

Neal.woodbury@asu.edu

Stephen.johnston@asu.edu